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Title: Optimal Transmission Line Switching under Geomagnetic Disturbances

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In recent years, there has been an increasing concern about how Geomagnetic Disturbances (GMDs) impact a reliable operation of electrical power grids. Of particular interest are the Geomagnetically-Induced Current (GIC) flows that can saturate transformers, resulting in hotspot heating and increased reactive power losses. Such negative effects can potentially cause catastrophic damage on transformers and severely impact the ability of a power system to reliably deliver power. Hence, we develop a model of transformer heating as a function of the regular Alternating Current (AC) and GIC, also integrate increased reactive power load into power flow equations. In this paper, we solve an optimization problem of minimizing the total generator dispatch cost and load shedding cost subject to AC power flow constraints and transformer heating constraints with an option of switching transmission lines. We employ state-of-the-art convex relaxations of nonlinear AC power flow equations and disjunctive bilinear relaxations to obtain tight lower bounds on the objective. We demonstrate on a modified IEEE RTS96 system (single area) that such a model is computationally tractable and the option of line switching is effective to mitigate the effects of GIC on the grid. We also provide a sensitivity analysis of operating decisions with respect to the directions of GMDs.

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